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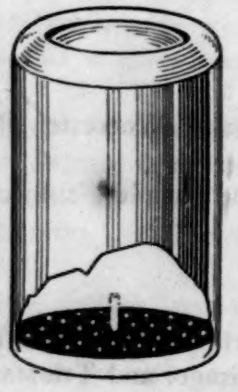

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CONTENTS

SURGICAL AND ANATOMIC EVIDENCE OF EVOLUTION[1]

* * * * * *

I PROPOSE in this address to approach evolution, not from the controversial side or from general arguments, but from a plain statement of a series of *facts,* many of them drawn from my personal experience as a surgeon and anatomist—facts which, to my mind, absolutely demonstrate the solidarity of animal life, more especially in the case of the vertebrates, such as fish, birds, other mammals and man, the highest mammal.

Many opponents of evolution admit the gradual development of animal life from its lowest form up to and including the anthropoid apes, but they draw the line there, basing this belief on the account in Genesis. Man, they insist, stands as a separate direct creation by the Almighty, "out of the dust of the ground." Such an argument is like declaring that the laws of mathematics reign in numbers up to, say, 100,000 or 1,000,000, but beyond that limit are no longer valid.

* * * * * *

Let me now point to facts—not theories but facts—which demonstrate this unity of the animal kingdom, including man.

1. Let me relate some operations I have done on the human brain. The brain in animals, including man, consists in a general way of (*a*) the cerebrum; (*b*) the cerebellum; (*c*) the spinal cord; and (*d*) certain structures which bind these three together. Extend the fingers straight forward. The fingers then resemble the "convolutions" on the surface of the brain; the furrows between them resemble the "fissures" between the convolutions of the brain. The principal fissures between the convolutions are similar in man and animals.

[1] Part of the Commencement Address at Crozer Theological Seminary, Chester, Pennsylvania, on June 6, 1922.

In the convolutions on the surface of the brain are certain small aggregations of motor nerve cells in the gray matter called "motor centers." On being stimulated by an electric current, these cells produce motion, each center in one definite portion of the body, and never in any other part. These motor centers are all grouped around the fissure of Rolando, which runs obliquely downward and forward above the ear. This, and another deep furrow called the fissure of Sylvius, are always readily identified in the lower animals. The motor centers for movements of the leg, arm, face, fingers, etc., in the brains of the lower animals, up to the anthropoid ape, have been exactly mapped out by experiments on animals. In the human brain the location of the corresponding motor centers is a duplicate of those in the brains of animals. Let me relate some striking cases to confirm this statement.

A young woman with epilepsy, in whom the attacks were constantly increasing in frequency and violence, insisted that her attacks always began in her left thumb, then spread to the hand, then to the arm, followed by unconsciousness and violent convulsions all over the body. Careful observation for two weeks in hospital confirmed her statements that the fits always did begin in this left thumb. If, then, I could prevent the fit from beginning in this thumb, so I reasoned, it might be that I could prevent the entire attack. Just as, in a row of bricks standing on end, if I can prevent the first one from falling, none of the others will fall.

The possibility of the exact localization of the little cube of gray matter on the surface of the brain, dominating all the muscles of the thumb, was the key to the whole operation. This localization of the thumb center had been made absolutely by experiments on the brains of animals. Accordingly, I opened her skull, identified the spot corresponding to the thumb center (*i. e.,* the great toe of the fore foot) in animals, and cut out a small cube less than an inch on each side.

Next, note the fact that there are nine muscles moving the thumb, some in the ball of the thumb, some between the thumb and the forefinger, some extending up the front of the forearm, and some up the back of the forearm, both of the latter reaching nearly to the elbow. Some flex and some extend the thumb, some separate it from the other fingers, and by one we can make the thumb touch each of the other four fingers. This is the motion which differentiates the human "hand" from the animal fore foot.

When this patient awoke from the ether, *every one* of these nine muscles was paralyzed and in *not a single additional muscle* was motion affected. The human brain center and the animal brain center for the thumb were proved to be *precisely identical.* My hopes were justified. Her epileptic attacks, which had occurred almost daily, recurred only about once in a year. In a few months she even regained full control over this thumb.

Two other later similar cases still further confirmed this wonderfully exact localization.

A fourth brain case: In 1888, I reported my first three cases of modern surgery of the brain. Attending the meeting of the American Surgical Association in Washington, when I read this paper, was Sir David Ferrier of London. He had contributed very largely to this then wholly new mapping of the brain centers which control motion. In one case, I described how I had stimulated a certain small, definite motor area in the brain of my patient by the battery,[2] and described the resulting movements of the arm at the shoulder. Ferrier afterwards said to me, "I could hardly restrain myself from leaping to my feet, for this was the very first demonstration on the human brain of the exact identity of my own localization of this very center in animals."

A fifth brain case: A midshipman in the United States Naval Academy at Annapolis, in 1902. I saw him three days after his accident. All the history I obtained was that he had been injured in a foot-ball game, had been unconscious for half an hour, and since then had complained bitterly of headache, which he located in his forehead. He was almost comatose, his pulse was only 52. There was no fracture of the skull. Soon after the accident, he developed local convulsions—note this care-

[2] The brain tissue itself is wholly devoid of sensation and can feel no pain.

fully—first in the right leg and later and chiefly in the right arm, but never involving the face. In six and a half hours he had had twenty-four of these convulsions, all in the right arm. The only evidence of a local injury was a slight bruise at the outer end of the left eyebrow. Had I seen this case prior to 1885—when I first made a careful study of the motor centers in the brain—I should have followed, of course, the only visible indication of the location of the injury to the brain, namely, the bruise. Had I opened his skull near the bruise, I should have been confronted with a perfectly normal brain. I should then have been compelled to close the wound and have perforce done nothing more. He would have died within two or three days.

But experiments on animals, after 1885, had shown that above the ear and a little in front of it lay the centers controlling the muscles of the face, the arm, and the leg, from below upwards, the leg center being near the top of the head.

As there was no fracture of the skull, and as the convulsions began first in the leg and then concentrated chiefly in the arm, but never extended to the face, my diagnosis was a rupture of the large artery on the surface of the brain over these motor centers; that the escaping blood had formed a clot, the edge of which first overlapped the leg center, but that the chief mass of the clot lay over the arm center. Moreover, I felt sure that it had not yet reached downwards over the motor center controlling the muscles of the face. Evidently, this clot must be immediately removed or he would quickly die. I opened his skull directly over the center for the arm muscles, and *far away from the bruise.* The opening in the skull at once disclosed the clot, the thickest part of which did lie exactly over the arm center, as I had foretold. I removed nine tablespoons (three-quarters of a tumblerful) of blood, which had caused the headache, the somnolence, the slow pulse and the convulsions; then tied the artery and closed the wound. He made an uninterrupted recovery. He entered the navy but some years later lost his noble life in saving his ship and the crew from destruction by a fire near the powder magazine.

Do not such exact localizations of the brain centers in animals, as directly applied to man, in hundreds, if not thousands of operations by now, most closely ally man to animals?

II. Go with me next into the Museum of the Academy of Natural Sciences in Philadelphia, and compare the skeleton of man with those of the lower animals. Practically, these animal skeletons all closely resemble the human skeleton, though when clothed with flesh and skin they look very unlike.

All of the ape and monkey skeletons are practically replicas of the human skeleton.

Look at the many skeletons with five toes—the prevalent or typical number—such as those of the cat, tiger, bear, elephant, etc.[3] Take, for instance, the front and hind legs that correspond to the arm and leg in man. Bone for bone, they are counterparts of the human skeleton—shoulderblade, humerus, radius and ulna (the two bones of the forearm), and those of the hand; with a similar correspondence in the bones of the hind leg and foot.

Nothing could be more unlike externally than the flipper of a whale and the arm and hand of a man. Yet you find in the flipper the shoulderblade, humerus, radius, ulna, and a hand with the bones of four fingers masked in a mitten of skin.

Observe the bones of the next chicken you eat. The breast bone of all birds has a great ridge developed to give a large surface for attachment of the large and powerful breast muscles for flight. You will find in the wing the counterpart of the shoulderblade, the humerus and the radius and ulna. The bones of the bird's wing, *i. e.*, the hand, are three in number, the bones corresponding to the little finger and the ring finger being absent. They are thus modified to support the feathers. It is a hand altered to suit the medium in which birds move so gracefully.

While undoubted evidence shows that man has existed for only about 500,000 years, the horse has a consecutive geological history of over 3,000,000 years. The skeleton of the earliest horse, which was scarcely larger than a cat, had four toes in front and three behind.

[3] Sometimes there are only four toes in the hind leg, or the fifth, if it exists, is rudimentary.

Gradually, all the toe bones except one—the middle toe—have been lost. But the second and fourth digits, though they do not show externally, are represented by two rudimentary bones, the two "splint bones." The horse of to-day walks literally on tip toe, for the hoof is the toe- or finger-nail.

III. The internal organs of the body have the same story to tell of likeness or identity. Let us first look at the *heart*. You all know there is a right side of the heart which sends the blood through the lungs to be oxygenated, and a left side, which sends the blood to all the rest of the body. Each of these sides has two cavities—the auricle to collect the blood, the other, the ventricle, with strong, muscular walls, to drive the blood on its long journey. These four cavities are all united into one heart, with an important *groove* on the surface, marking a partition between the two auricles above and the two centricles below.

A steady, rhythmical action of the four cavities is essential for the proper propulsion of the blood, and, therefore, for health and life. The four cavities act, not all at once, but in succession, like the feet of a walking horse—1, 2, 3, 4; 1, 2, 3, 4, each foot having its own number. Until 1892 we did not know exactly what regulated this orderly sequence. In that year, the younger Professor His discovered that in the groove between the auricles and the ventricles there was a small bundle of muscular fibers which existed as one bundle until it reached a certain point. There it divided into two smaller bundles, one going to the muscles of the right side of the heart, and the other to those of the left side.

But the great importance of this "bundle of His" was not fully appreciated until twelve years later (1904). If, under an anesthetic, an animal's chest is opened, the heart laid bare, and this "bundle of His" is injured, the rhythm of the heart is at once disturbed. Instead of 1, 2, 3, 4, the order in which the hoofs struck the ground might be 1, 4, 2, 3, or 1, 3, 2, 4, etc. This fluttering of the heart threatens life. If the bundle is destroyed, death quickly follows.

In man, such physiological experiments, of course, are forbidden, but occasionally disease maims or destroys this bundle of His in the human heart itself. A small tumor named a gumma, in a few cases, has formed directly in or near the bundle of His, and in some cases has destroyed it. This has deranged the action of the heart of the human patient, just as the physiologist did in the experimental animal. Severe flutterings of the human heart, with difficulty of breathing, a pulse slowed down from 72 to 20, 10 or even 5 in the minute were observed. Not seldom sudden death occurred. The post-mortem in these cases disclosed the tumor, or other cause, which had injured or destroyed this bundle of His, and was the immediate cause of death.

Now, this bundle of His is found in all vertebrates, in man and other mammals, in birds, and even in frogs and fishes. Does not this show a solidarity of the entire animal kingdom? Do not so many such exact parallels between the human and the animal body strongly suggest a close inter-relation of the two?

Even plants convey the same message. I have seen Professor Bose, of Calcutta, put plants to sleep with ether and chloroform. If enough is given, they are killed just as a man is killed. If only a moderate dose is given, the plant passes into a state of greatly lessened activity, which may be well called sleep. When the anesthetic is withdrawn, it gradually wakens and returns to its normal activity, just as a man does.

One can even descend still further down in the scale to the bacteria, that is, germs visible only by the microscope. As Welch, of the Johns Hopkins, points out, "The gentle killing of certain bacteria by chloroform enables us to detect in their bodies toxic [poisonous] substances which are destroyed by more violent modes of death."

IV. The Liver and the Ductless Glands. Everybody knows that the liver secretes bile, or gall. The bile, which is necessary for proper digestion, is discharged into the intestine through a tube called the bile duct. The gall bladder is simply a reservoir for extra bile, and a sturdy means of support for us surgeons, especially in the late hard times—by reason of the dangerous gall stones which form in it and require removal by a surgical operation.

Now, in 1848, Claude Bernard, of Paris, one

of my own teachers in the middle sixties, discovered that the liver had a second function totally unsuspected until then. Practically all the blood from the intestines goes through the liver on its way back to the heart. Bernard opened the abdomen of a fasting animal, drew some of the blood *before* it entered the liver, and also some of the blood *after* it had gone through the liver. He found that the blood, before it entered the liver, was sugar free, but after it emerged from the liver, it always contained *sugar*. This was the first step in the scientific study of diabetes, in which there is an excess of sugar which is excreted through the kidneys.

But the liver has no second duct or tube for the discharge of this sugar into the blood current. Being in solution, it soaks through the thin walls of the blood vessels into the blood current as it passes through the liver.

Following this, came later the discovery of the now numerous "ductless glands" of which we have learned so much chiefly by animal experimentation in the last few years. Some of them, though only as large as a pea, are essential to life itself.

V. Let me now say a few words about one of the most important of these ductless glands —the thyroid gland in the neck. When it becomes enlarged it is familiar to us as a "goiter."

From this gland, as in the case of the liver, there soaks into the blood stream a secretion of great importance to life. If the gland is rudimentary, either in substance or in function, it results in that form of idiocy known as cretinism. As a remedy we have learned to administer an extract from the thyroid glands of animals. The remedy is usually remarkably successful.

In certain conditions, goiter is very prevalent in the thyroid gland of brook trout. It has even threatened to destroy the culture of these food fishes.[4] By the administration of iodin, this disease has been prevented in the trout. As a result of this success, the same method has been found efficient in preventing goiter in human beings.

Here, again, you perceive the solidarity of the animal kingdom in such identity of function that the thyroid gland of animals, when given as a remedy to man, performs precisely the same function as the human thyroid. Moreover, it is not the thyroid gland from the anthropoid apes that is used as a remedy, but that from the more lowly sheep.

VI. The Sympathetic Nerve and its wonderful phenomena. When I was a student of medicine, one of our text books was Dalton's Physiology. In connection with the sympathetic nerve, there was a picture of a cat, of which the Chessy cat of *Alice in Wonderland* reminded me, for in both only the face was pictured.

The sympathetic nerve is a slender cord about as thick as a fairly stout needle. It runs vertically in the neck, alongside of the carotid artery and the jugular vein, and so close to them that a dagger, a knife or a bayonet thrust, or a bullet which would cut the nerve, would almost surely cut the great artery and the vein. The patient then would bleed to death in a few minutes and never reach a hospital. Hence, no one had ever had a chance to observe the effects following division of this nerve in man. Before Brown-Séquard's experiment in animals, in 1852, its function, therefore, was entirely unknown. By a small incision he exposed the nerve in the neck of a cat, rabbit and other animals, divided the nerve, and observed what happened. The small wound healed quickly.

These results were as follows: 1. The pupil of the eye on the same side as the cut nerve diminished from the normal large sized pupil in the cat to almost the size of a pin hole. 2. The corresponding ear became very red from a greatly increased flow of blood, *i. e.*, the blood vessels were greatly dilated. 3. On that side there was increased sweating, that is, the sweat glands became very active as a result of the increase in the blood supply. 4. The temperature increased to a marked degree; in rabbits, by seven to over eleven degrees Fahrenheit.

Dalton's picture of the cat could not be forgotten because the two pupils differed so greatly in size.

In 1863, during the Civil War, when I was assistant executive officer of a military hospi-

[4] Kimball: *American Journal of the Medical Sciences*, May, 1922, p. 634.

tal, one day a new patient approached my desk just as I was about to sign a letter. The moment I looked up at him I was struck with his appearance and instantly said to myself, "Surely you are Dalton's cat." "Where were you wounded?" I quickly asked. He pointed to his neck and I said to myself, "His sympathetic nerve must have been cut." Further careful observation showed the reddened ear, the increased temperature, the sweating and the greater flow of saliva, thus confirming in every particular the results of Brown-Séquard's experiments on animals. It is interesting to know that this was the very first case in surgical history in which division of the sympathetic nerve had ever been observed in man.

Further experiments on this little nerve in animals revealed a wholly new world of most important phenomena. It was discovered that the sympathetic nerve sent branches to every artery in the body, from head to foot. Now the arteries are tubes, like the water pipes in a house, not, however, of rigid metal but soft and flexible, for they consist largely of muscular fibers which contract or relax automatically, making the arterial tubes of a larger or a smaller diameter according to the need for more or less blood.

For instance, just before a meal, the stomach is of a yellowish color. Not a single blood vessel is to be seen. An hour later the stomach has become so red that it seems almost as if the wall of the stomach is made up of nothing but blood vessels. This greatly increased supply of blood is needed to secrete gastric juice for the digestion of our food. As the food is digested, less and less blood is needed, the caliber of the arteries is gradually diminished by the contraction of the muscular wall of the arteries until the stomach looks as bloodless as before breakfast.

How fortunate that all this is automatic! Were it not, and after breakfast you forgot to order an increasing supply of blood for digestion, or if after digestion was accomplished, you forgot to shut off the blood, what would become of you?

The iris, the colored circular curtain inside the eye, with a round, black hole in the center called the pupil, is under similar automatic control of this sympathetic nerve. The iris is like a wheel. Around the pupil there are circular fibers which one may call the hub, while the rest of the iris consists of radiating fibers corresponding to the spokes. When you go out of doors, the bright light at first almost blinds you, but very quickly the circular fibers around the pupil contract so that the pupil becomes as small as a pin hole and protects the retina. On going into a dark room, at first you stumble over the furniture, but in a few moments the radiating fibers pull the pupil wide open and you see clearly everything in the room.

When you blush from emotion, the arteries of your skin have dilated. When you turn pale with fright, the caliber of your arteries is lessened, and if the arteries going to your brain supply too little blood, you fall in a faint. When you cut your hand, you know how all around the cut the redness shows that the arteries have dilated to furnish extra blood for the repair of the injury, and when the wound is healed, your blood vessels again contract and the redness at last disappears.

All these processes also are automatic. You do not have to remember to order blood to or from a cut hand, or to contract or widen the pupil, etc. It is all done for you; in fact, it is done in spite of you, for you have not the least control over these varying conditions. The automatic action of this nerve is of the utmost importance for many functions involving life itself.

I could go on almost indefinitely with a multitude of similar illustrations. All of our knowledge of these facts started from Brown-Séquard's little experiment of cutting the slender sympathetic nerve in the neck of an animal.

VII. Another evidence of our animal origin is found in organs which are well developed and actively functioning in some of the lower animals, but which in man are only rudimentary. The best known example of this is the appendix, which, in some of the lower animals, is well developed and functions actively. Its frequent inflammation is also a good example of the fact that such imperfect vestigial organs are very prone to disease and often require the

surgeon's skill to avert disaster. The only really safe place for the appendix is in the surgeon's collection of trophies.

VIII. Let us now turn to the very significant evidence of our animal origin in the embryonic development of man. I have time to note but a single, though very enlightening instance.

During pre-natal development in man, between the two upper jaw bones is a triangular bone which carries the four upper incisor or "front teeth." At birth, and afterwards, there is normally no such bone because it has become fused on each side with the upper jaw bone. In sheep and some other animals, this always persists as a separate bone called the pre-maxillary bone. Now note a curious defective development in human fetal life. Sometimes this pre-maxillary bone, in the human embryo, fails to unite with the upper jaw bone on the right or the left side, and then we have what you all know as "cleft palate." If not only the bones fail to fuse together, but this failure extends also to the lips, we have a "hare lip." We see in some cases only a cleft palate, in others only a hare lip, in still others, both hare lip and cleft palate.

When there is such a deformity, it *never* occurs in the middle line, or any indifferent place, here or there, but invariably to the right or the left side and corresponding exactly to the site of the failure of this pre-maxillary bone to unite with the upper jaw.

Is not such an exact correspondence between the anatomy and development of the sheep and of the child most significant of the ancestry of the human body?

IX. Lastly, there have been discovered several grades of actual prehistoric men. Their skeletons or skulls, their flint instruments, and the remains of their fires are evidences of the grade of their several civilizations. This chain of human ancestors was unknown to Darwin, for they have been discovered since his death.

I have myself seen in the caverns of southern France the extraordinary and convincing evidences of the assured existence of our immediate ancestor, the Cro-Magnan man, who lived about 25,000 years ago. There are to be seen the work of the first painter and the earliest sculptor, prehistoric Sargents and Rodins of remarkable skill.

Before the Cro-Magnan man was the Neanderthal man, "whom we know all about, his frame, his head-form, his industries, his ceremonial burial of the dead," as Dr. Henry Fairfield Osborn has pointed out. Before him was the Piltdown man; before him the Heidelberg man; still earlier, in Java, the Trinil man; and still further back in geologic time was the Foxhall man—all named for the localities in which their remains were found. This earliest Foxhall man lived in England before the Great Ice Age, about 500,000 years ago.

The differences between the highest anthropoid apes and the lowest man gradually grow less and less the further we trace them backwards. We must clearly understand that no existing species of anthropoid apes could have been our ancestors. They and we are collateral descendants from ape-like species living far, far back in geologic time; before, and probably long before the Great Ice Age. The earth is very big, the various excavations have covered only a very minute part of its surface during only half a century. Every discovery has but confirmed the wonderful story of the ascent of man. Bateson, himself, who has been misquoted as an opponent of evolution, says: "Let us proclaim in precise and unmistakable language that our faith in evolution is unshaken. Every available line of argument converges on this inevitable conclusion."

Man's ascent from an animal of low intelligence seems to me to be absolutely proved by the many phenomena which reveal identical organs and physiological processes in the animal and the human body, a few of which, chosen out of a very great number, I have described. It is confirmed by the discovery of the remains of a number of prehistoric men, as is now definitely proved. This ascent of man, in perfectly orderly sequence, is far more probable than that evolution progressed up to the anthropoid apes and stopped there, and that God then made man by a separate, special, creative act, yet—*mirabile dictu*—with all these minute and exact correspondences of similar structures and functions in animals. Microscopically, the various structures in man and

animals are practically identical. Even the tiny muscles moving the wings of insects, such as the fly and the mosquito, resemble microscopically the muscles of man.

If man was a special creation, the Almighty was not limited to the lowliest form of matter—the "dust of the ground"—as material for the human body. He could have created a nobler, a more subtle, a more puissant and exalted stuff out of which to fashion man. The plan and structure and function of man's body would then supposedly have differed *toto coelo* from man's present body. Probably it would have been free from the defects and deformities inherent to the animal body, and free from the diseases which it shares with animals.

But, no! God deliberately made man out of the same stuff as the animals, and, as I have shown, on the same plan as animals. Bodywise, man *is* an animal, but, thanks be to God, his *destiny* is *not* the same as that of the beasts that perish. To develop great men, such as Shakespeare, Milton, Washington and Lincoln, and then by death to quench them in utter oblivion, would be unworthy of Omnipotence. To my mind, it is simply an impossible conclusion. Man's soul *must* be immortal.[5]

* * * * * *

W. W. Keen

CULTIVATION AND SOIL MOISTURE

The question of cultivation in relation to soil moisture is one on which there has been difference of opinion among agricultural workers. The work of Professor Call of Kansas has tended to show that (under his conditions) cultivation, as cultivation, does not conserve soil moisture.

Since 1913 the writer has been engaged in agricultural work where the question of cultivation in relation to the conservation of soil moisture has been important. In the early years of this work the surface mulch idea, which is quite generally accepted by agriculturalists, was believed and used to explain the presence of ample moisture under cultivation when there was a deficiency without cultivation. When other features of plant growth were investigated some effects of cultivation, other than moisture, were brought out.

The recent controversy between Dr. Jerome Alexander and Mr. L. S. Frierson in the September 2, 1921, the February 10 and March 24, 1922, issues of Science has been interesting. One of these writers accepts the general view that cultivation of the surface of the soil conserves soil moisture by preventing surface evaporation, while the other does not believe that this is in accord with engineering experience. If our work had shown that, in cultivation, we were dealing with a moisture factor alone, the writer might agree with one of these two men without going into the specific conditions under which the data were obtained. Our work has shown that cultivation changes the composition of the soil solution and has an effect on the water requirements of the plants grown.

The Journal of Industrial and Engineering Chemistry for March, 1922, Vol. 14, No. 3, has the following in an article by the writer in discussing a composition basis for the water requirements of plants: "There is a common saying, cultivate to conserve soil moisture and you will have larger crops. The author believes that cultivation lets air down into the soil, thereby increasing bacterial activities which in turn cause the plants to get more food and grow larger on less moisture, would be nearer the truth. Experiments are reported where fertilization has decreased the water requirements of plants over one half, when expressed as the amount of water necessary to produce one unit weight of plant.

In the field experiments we had plants growing well, *with* cultivation, when on the same soil *without cultivation,* lack of water in the soil was hindering plant growth. It was easy to say that these were the results of cultivation in conserving soil moisture but to find out how the mulch conserved the soil moisture was a problem for intensive study. The evident facts were that the well cultivated crops were not suffering from lack of water in the period of dry weather.

It was found that the soil having the water reserve had a higher concentration of plant food and the plants growing in this soil con-

[5] The full address will appear in the *Philadelphia Public Ledger* for Sunday, June 11.

tained larger quantities of the plant food elements. Plants of the same species are known to vary in analysis and plants of different analyses in our experiments were found to have different water requirements. It appears that if the soil solution is weak the plant transpires more water in its attempt to make a normal growth. The larger number of stomata on the leaves of plants with high water requirements substantiate this.

The results of cultivation are a different plant growing in a different soil and requiring less water per unit of weight.

In the spring the soils of the humid regions of the United States contain plenty of water and it is general observation that the results of cultivation (higher moisture in the soil) do not show up until periods of dry weather come. In the fall there is again plenty of water, under all systems of soil management. It is the author's belief, based on experimental results, that proper cultivation throughout the season will allow the plants growing on good soils to make their growth on enough less moisture (early in the season) so that they can keep on growing during periods of dry weather on what may be called an accumulative moisture reserve.

The summary of the water requirement paper in the *Industrial Journal* follows:

The results of field and greenhouse experiments recorded in the following paper indicate that fertilization of a soil which responds to direct or indirect fertilizer treatment allows the plants to make their growth on a smaller amount of water and to have a different composition from what they otherwise would.

The same effect is produced by cultivation, which by opening up the soil increases bacterial activity, which in turn gives increased concentration of the soil solution.

Proper fertilization and cultivation minimize dangers to crops from drought injury in humid regions of the United States by having the plant go into the drought period with an accumulative reserve of soil moisture.

This work opens up the study of fertilization from the basis of water requirement.

H. A. Noyes

Mellon Institute of
Industrial Research

THE COPPER ESKIMOS

I returned in the autumn of 1921 from six consecutive years in the arctic regions. Three of these were spent for purposes of geographic and ethnographic study among the Copper Eskimos. I am now engaged upon writing up the results of that investigation, but, as there is no prospect of getting this printed before at least one year, I want to make a preliminary announcement about certain results of my archeological and ethnological work.

Previous to 1912, the eastern known limit of pottery among the Eskimos was Point Barrow (cf. Murdock on the Point Barrow Eskimos). Stefansson's work of the years 1908-12 extended the known pottery area eastward some six or seven hundred miles to Cape Parry, and he found it there in the most ancient ruins, indicating that pottery has been used by the Eskimos for centuries and perhaps by the earliest Eskimos who occupied that country.

Jenness has published the results of his two years spent among the Copper Eskimos (*Report of the Canadian Arctic Expedition,* 1913-1918, Vol. XII, published by the Department of the Naval Service, Ottawa). In this he does not mention pottery, which would indicate that he found none to the east of Cape Parry. In excavating various sites I have found pottery fragments as far east as Point Agiak, just west of Gray's Bay, or about 80 miles east of the Coppermine. This extends the known pottery territory some 400 miles east beyond Stefansson's results. Like Stefansson, I found the pottery deep down, indicating that it had been in use probably several centuries ago and perhaps by the earliest Eskimos. The implements associated with the pottery were of undoubted Eskimo type.

Previous to 1910 houses of earth and wood had not been reported from the western arctic coast of Canada further east than Pierce Point. Stefansson in his journeys along the coast the spring of 1910 and again the summer of 1911 found the ruins of earth and wood houses as far east as one mile east of Crocker River. In an appendix to Jenness' report (cited above) we learn that since his return in 1916 Captain Joseph Bernard, who entered the Copper Es-

kimo country only a few months after Stefansson in 1910 (see *My Life with the Eskimo,* by V. Stefansson, p. 258) has reported finding the ruins of houses made of earth and wood on southwestern Victoria Island. Jenness concludes that this is a sporadic occurrence and attributes it to a visit from the western Eskimos. Thus Jenness evidently assumes that the people from whom the present Copper Eskimos are descended never had wooden houses.

In 1919 A. H. Anderson found earth and wood houses on Cape Krusenstern and at various places in Coronation Gulf. Lastly, I have (during the years of 1917-1921) found ruins of the type of earth and wood houses used in Alaska and the Mackenzie River at intervals along the shores of Coronation Gulf to the above-mentioned Point Agiak. I also have accurate Eskimo information about the location of a village of the same type on the coast of Melville Sound due south of Kent Peninsula. Thus we find houses of wood and earth as far east as West Longitude 107°. For reasons which I cannot go into here, I consider it likely that future investigations will show a continuation of this chain of ancient earth and wood dwellings most if not all the way to Atlantic and Hudson Bay waters.

As it seems to differ from that of some other investigators, I want to record here the opinion (based on my studies in Coronation Gulf) that the present Copper Eskimos, who have no pottery and use no wooden houses, are in the main at least descendants of the earlier inhabitants who used pottery and wooden houses. My view is that the present culture (characterized in part by stone pots instead of pottery, and snowhouses instead of wooden houses) has been gradually evolved partly because the previous culture was never as well suited to the local conditions as the present, and partly because the local conditions have changed somewhat. One important feature of the change has been the lessening importance and eventual abandonment of whaling. My work shows that whaling was formerly practiced in certain parts at least of the Copper Eskimo country.

HAROLD NOICE

THE EXPLORERS CLUB,
NEW YORK CITY

SCIENTIFIC EVENTS

THE BRITISH INSTITUTE OF PHYSICS

AT the annual general meeting of the British Institute of Physics, held on May 23 in the rooms of The Royal Society, the following officers and board were elected to serve for the year beginning October 1, 1922: *President,* Sir J. J. Thomson; *past president,* Sir R. T. Glazebrook; *vice-presidents,* Sir Charles Parsons, Professor W. Eccles, Professor C. H. Lees, Mr. C. C. Paterson; *non-official members of the board,* Dr. R. S. Clay, Professor C. L. Fortescue, Professor A. Gray, Major E. O. Henrici, Sir J. E. Petavel, Dr. E. H. Rayner, Sir Napier Shaw, Mr. R. S. Whipple; *representatives of participating societies*—Physical Society, Mr. C. E. Phillips, Mr. F. E. Smith; Faraday Society, Mr. W. R. Cooper; Optical Society, Mr. John Guild; Röntgen Society, Dr. G. W. C. Kaye; Royal Microscopical Society, Mr. J. E. Barnard.

The annual report stated that there were 408 members of the institute at the end of the year, of whom 258 were fellows.

The institute is watching the possibility of establishing a central library for physics, although the financial difficulties in the way of its realization are stated to be considerable.

In the course of his presidential address Sir J. J. Thomson, after dealing with the project to establish a *Journal of Scientific Instruments,* spoke of the present depression in industry, but he made the reassuring statement that out of 67 students who graduated with distinction in physics and chemistry in 1921, 46 had obtained suitable positions, while 14 were doing research work. He hoped that the series of lectures on physics in industry which had been established would act to some extent as "refresher courses."

Speaking of the difficulties which the safeguarding of industries act had, in many instances, placed in the way of research, he characterized research itself as a "key industry" and he hoped that the government would put every facility in the way of research workers being able to obtain without delay the apparatus they required.

THE RADIO SERVICE OF THE UNIVERSITY OF WISCONSIN

EXTENSIVE new radiophone broadcasting services were started by Station WHA, University of Wisconsin, on Monday, May 29, to be continued throughout the summer and until further notice.

Noonday radio broadcasts, consisting of five- or ten-minute talks, will be sent at 1:05 p.m. five days each week. These talks will be by members of the university faculty and in many cases will be delivered in person. They will be on subjects of general interest and will enable the public to hear university men talking on subjects on which they are authorities.

A Tuesday night university radiophone lecture course was started on May 30. At 8 o'clock every Tuesday night a university professor will broadcast a twenty-minute lecture on a subject of general interest. The first lecture was a Memorial Day address delivered by Professor W. F. Lorenz, major in the Thirty-second Division, now actively associated with the rehabilitation of disabled soldiers.

These new broadcasting services will not affect the present services of University Station WHA. It will continue the Friday night musical appreciation course and radiophone news service of the University Press Bureau, as well as the daily market and weather reports and services for amateurs.

The schedules of each week in the new lecture courses will be sent to the newspapers in advance. The program of the first week was as follows:

1:05 Monday, May 29—"The Wisconsin Spirit," by Professor E. H. Gardner.

1:05 Tuesday, May 30—An address by President E. A. Birge.

8:00 Tuesday, May 30—Memorial Day address by Major Lorenz.

1:05 Wednesday, May 31—"The Medical Clinic," by Dr. J. S. Evans, director.

1:05 Thursday, June 1—"Spring Sports" by a member of university athletic department.

1:05 Friday, June 2—Readings by Dean F. W. Roe, of the English department.

SCIENTIFIC EXHIBIT AT THE MEETING OF THE AMERICAN MEDICAL ASSOCIATION

THE *Journal* of the American Medical Association states that this year the exhibit exceeded expectations in the number of exhibitors, while the quality of the work shown was of a high order. The setting for the exhibit was much better than usual; the booths were of pleasing appearance, painted green with white trimmings, and with overhanging plants. As has been customary, the exhibit was classified. The educational section included a number of exhibits of charitable or semi-public organizations. Probably the pathologic section was the most interesting. Here one found such exhibits as that on pelykography (Dr. Reuben Peterson, University of Michigan); studies on ringworm fungi (Mr. Robert Hodges, University of Alabama); specimens of flagellate protozoa under well illuminated microscopes (Dr. Kenneth Lynch, Dallas, Texas); work on the bile factor in pancreatitis (Drs. F. C. Mann and A. S. Giordano, Mayo Clinic); gross pathologic specimens and comparative Roentgen ray records (Dr. Eugene Opie, St. Louis), and the excellent work on renal circulation (Department of Urology, University of California). The most striking exhibit in the surgical section was the display of plaster casts and comparative photographs dealing with facial surgery; one half of the exhibit was devoted to civilian work, the other half to war reconstruction (Dr. Vilray P. Blair, St. Louis). In the medical section the diagnosis of syphilis from the laboratory point of view was well presented (Dr. Loyd Thompson, Hot Springs, Ark.); in another booth was an interesting exhibit of pigeons illustrating vestibular tremors (Dr. C. L. Woolsey, Boston). In addition to the foregoing were a large number of electrocardiographic exhibits. The total number of exhibitions was 48, thus divided: educational, 12; pathologic, 10; surgical, 6; medical, 6; electrocardiographic, 14. On the stage of the auditorium the work of the various councils and the chemical laboratory of the American Medical Association was shown.

The committee on awards, consisting of Drs. W. B. Cannon, George Dock and Louis B. Wilson, made the following recommendations:

The Gold Medal to Drs. Frank Hinman, D. M. Morison, A. E. Belt and R. K. Lee-Brown, of the University of California Medical School, for a study of renal circulation.

The Silver Medal to Mr. Robert A. Hodges,

University of Alabama, for a study of certain culture-medium characteristics of ringworm fungi.

The Certificate of Merit to Dr. Vilray Papin Blair, St. Louis, for an exhibit of photographs and plaster casts showing various types of face restoration.

The committee also desires to give honorable mention to the following exhibitors:

Dr. K. M. Lynch, Dallas, Texas, for a study of the cultivation and differentiation of flagellate protozoa.

Drs. F. C. Mann and Alfred S. Giordano, Mayo Foundation, Rochester, Minn., for studies on the bile factor in pancreatitis.

Dr. Eugene Opie, Washington University, St. Louis, for a comparison of Roentgen ray records and gross pathologic specimens.

Miss Elizabeth Green, Barnes Hospital, St. Louis, for a demonstration of methods used in distributing books in hospitals.

THE ROME MEETING OF THE INTERNATIONAL GEODETIC AND GEOPHYSICAL UNION

Some 300 delegates and guests attended the meetings at Rome, May 2 to 10, of the Geophysical Union and of the Astronomical Union. Every country belonging to the unions had sent one or more representatives. There were besides present representatives from other countries (the neutrals during the late war), which have already joined the International Research Council and are making preparations to join one or more of the unions. The delegates from the United States for geodesy and geophysics were: Bowie, Bauer, Kimball, Littlehales Reid and Washington. All of the sections reported well-attended, successful and stimulating meetings.

Among the special social features, abundantly provided for by the Italian National Committee, were the following:

May 2, 3 p.m.—Inaugural ceremony at the Campidoglio, at which H.M. the King of Italy was present.

May 4, 9 p.m.—Reception of the delegates at the Campidoglio by the municipality of Rome.

May 8, 3 p.m.—Visit to the Palatino at the invitation of the under-secretary of antiquities and fine arts.

May 10, 1 p.m.—Visit to the Vatican and audience with the Pope.

After the meetings, various special trips were arranged for. Thus on May 12 visiting delegates were entertained by the municipality of Florence.

The Sections of Seismology and Volcanology were definitely organized, as well as a new section of Scientific Hydrology.

Professor C. Lallemand was reelected president of the union for two terms. The next meeting of the union will be at Madrid in 1924.

Louis A. Bauer

SCIENTIFIC NOTES AND NEWS

Dr. W. W. Campbell, director of the Lick Observatory, has been elected president of the International Astronomical Union in succession to M. Baillaud, director of the Paris Observatory. The Astronomical Union held its triennial meeting in Rome in May and will hold its next meeting in Cambridge, England.

Dr. Ray Lyman Wilbur, president of Stanford University, has been elected president of the American Medical Association for the meeting to be held next year at San Francisco.

Dr. Louise Pearce, of the Rockefeller Institute for Medical Research, has been elected a corresponding member of the Société belge de Médécine tropicale of Brussels, Belgium.

The John Scott Medal of the Worcester Polytechnic Institute was awarded at the commencement exercises to Elwood Haynes, head of the Haynes Automobile Company, in recognition of his discoveries in certain forms of high speed steels.

Mr. Gano Dunn, president of the J. G. White Engineering Corporation of New York, has been elected a member of the board of trustees of Barnard College, Columbia University.

Dr. F. Rossi, of the University of Bologna, has been awarded the Garibaldi Franco-Italian prize offered by the French Surgical Society for his work on "War Wounds of the Thorax."

Dr. E. Perroncito has reached the age limit and will retire from the chair of parasitology in the University of Turin. A celebration in his honor has been planned and subscriptions

will be received by the Perroncito Committee, via Nizza 52, Turin, Italy.

DR. NORMAN MACLEOD HARRIS, of Dalhousie University, has been appointed chief of the division of medical research of the Canadian Dominion Department of Health.

SIR THOMAS HENRY HOLLAND, F.R.S., formerly director of the Geological Survey of India and later professor of geology in Manchester University, has accepted the invitation of the governing body of the Imperial College of Science and Technology, London, to be rector from September 1 next, in succession to Sir Alfred Keogh, who is retiring under the age limit.

MR. D. D. BEROLZHEIMER, assistant technical editor of the *Chemical Engineering Catalog* and co-author of the *Condensed Chemical Dictionary,* has been appointed manager of the Information Bureau of The Chemical Catalog Co., Inc., and of that of the service department of *The Journal of Industrial and Engineering Chemistry.*

ELBERT A. WILSON has resigned as director of the Pyralin Research Laboratory of the E. I. DuPont de Nemours and Company to enter private practice as a consulting chemical engineer.

MR. HARRY E. RICE has severed his connection with the R. R. Donnelley and Sons Co., printers, of Chicago, where he has been employed for several years in the capacity of chemist. He is now in charge of research and development work for the American Printing Company, also of Chicago.

THE following have been appointed as the official delegates of the United States to the International Chemical Conference at Lyons: C. L. Parsons, *chairman;* E. W. Washburn, *vice-chairman and secretary;* R. B. Moore, H. S. Washington, Edward S. Chapin and Edward Bartow.

DR. LOUIS A. BAUER, after attending the meetings of the International Geodetic and Geophysical Union, sailed from Marseilles on May 19 for Australia, where he will inspect the Watheroo Magnetic Observatory of the Department of Terrestrial Magnetism. He expects to visit the magnetic observatories in New Zealand and Samoa, returning to Washington early in September.

DR. AUGUST KROGH, professor of comparative physiology at the University of Copenhagen, who received the Nobel prize for medicine in 1920, will visit the United States in the autumn.

DR. LEONHARD STEJNEGER, of the U. S. National Museum, will spend the summer in the Commander Islands and other points of interest in and around Bering Sea. He expects to return in October.

DR. R. D. RANDS, for the past three years engaged in rubber disease research for the Dutch government at Buitenzorg, Java, has recently returned to this country and accepted an appointment as pathologist in the Office of Cotton, Truck and Forage Crop Disease Investigations, Bureau of Plant Industry. Dr. Rands will take charge of the department's work on diseases of beans, with headquarters in Washington.

THE *Journal of Industrial Chemistry and Engineering* reports that on May 10, the Society of Industrial and Micrographic Photography was organized at the Chemists' Club in New York. A further meeting to discuss and ratify the constitution and by-laws will be held on June 14. In the interim the following serve as an executive committee charged with preparing the constitution: *President,* James McDowell, Sharp and Hamilton Manufacturing Company, Boston; *secretary and treasurer,* Thomas J. Keenan, editor of *Paper,* New York; *vice-presidents,* J. H. Graff, Brown Company, Berlin, N. H., Bennett Grotta, Atlas Powder Company.

AT the annual meeting of the Congress of Physicians and Surgeons of North America, Dr. Frank Billings, Chicago, was elected president. Presidents of societies meeting with the congress were elected as follows: American Association of Pathologists and Bacteriologists, Dr. Paul A. Lewis, Philadelphia; American Climatological and Clinical Association, Dr. Charles W. Richardson, Washington; American Laryngological, Rhinological and Otological Society, Dr. Dunbar Roy, Atlanta, Ga.; American Ophthalmological Society, Dr. William H. Wilmer, Washington, D. C.; American Bron-

choscopic Society, Dr. Samuel Iglauer, Cincinnati.

PROFESSOR LEWELLYS F. BARKER, of the Johns Hopkins University, will give the annual address at the tenth annual meeting of the Eugenics Research Association to be held at Cold Spring Harbor on June 10. His subject is "Heredity and the endocrine glands."

DR. WILLIAM H. WELCH, director of the School of Hygiene and Public Health, Johns Hopkins University, gave the commencement address at Bryn Mawr College on June 8.

DR. FREDERICK V. COVILLE lectured before the Gamma Sigma Delta of Kansas State Agricultural College on April 26 on "The influence of cold in stimulating the growth of plants." At Manhattan Dr. Coville spoke before the staff of the experiment station on "Acid tolerant plants" and related topics.

PROFESSOR R. B. MOORE, of the Bureau of Mines, delivered a public lecture on "The manufacture of helium by the government of the United States of America" at University College, London, on May 24. The chair was taken by Professor J. Norman Collie.

DR. JACOB G. LIPMAN, of the New Jersey Agricultural Experiment Station, who is now traveling in Europe, delivered two lectures in Paris recently, the first before the Académie d'Agriculture on the condition of agriculture in the United States, the other before the Société de Chimie Industrielle on the fertilizer industry in the United States.

DR. GEORGE E. DE SCHWEINITZ, retiring president of the American Medical Association, has accepted the invitation to deliver the Bowman Lecture in London, in 1923.

THE medical profession and allied scientific bodies of Philadelphia are arranging for a celebration of he centenary of Pasteur's birth on December 27.

EMERSON MCMILLIN, a New York banker, who took an active interest in scientific work, died on May 31, at the age of seventy-six years.

JOHN ALLEN WYETH, founder and for forty years professor of surgery in the New York Polyclinic, died of heart disease, on May 28, at the age of seventy-seven years.

ERNEST SOLVAY, distinguished for his process for the manufacture of soda, died in Brussels on May 26, at the age of eighty-five years. M. Solvay made large gifts for scientific and educational purposes.

DR. RENÉ BENOIT, former director of the International Bureau of Weights and Measures, corresponding member of the Academy of Science and of the Bureau of Longitudes, has died in Dijon at the age of 78.

A MEETING was held in Toronto on April 28, of which the result was a resolution to form a Canadian Metric Association. A temporary committee was formed to draft a constitution and inaugurate action toward more definite efforts to popularize the system for the benefit of science and industry.

THE Western Psychological Association announces the postponement of its annual meeting, originally announced to be held at Salt Lake City on June 22 and 23. A meeting will probably be arranged at Stanford University later in the summer.

THE New England Intercollegiate Geological Excursion will have as its leader for the coming fall Dr. Ernst Antevs, who has been carrying on the work of Baron de Geer since the return of the latter to Sweden. Dr. Antevs will demonstrate the field methods used by him to obtain a record of the retreat of the ice since the glacial epoch. The excursions will be held on October 6 and 7, and the geologists will begin their investigations at Springfield, Massachusetts, following the Connecticut River northward.

THE twelfth season of the Laguna Marine Laboratory of Pomona College will begin on June 21 and will last six weeks. Besides general classes in general biology and marine zoology, there will be opportuniy for special investigators. Eight private laboratories are provided for individual work. Dr. W. A. Hilton will be in charge.

THE Division of Geology and Geography of the National Research Council has been informed by Professor Émile de Martonne, of

the Sorbonne, Paris, that he has undertaken to direct the publication of a collection of photographic albums of the French regions. About sixty albums of fifteen plates each are projected, each picture to be chosen by Professor de Martonne, and to have about four lines of descriptive text. A high-grade mechanical reproduction is contemplated. Each picture will be reproduced in the form of a lantern slide. The publisher is Baudinière, 23 rue du Caire, Paris.

UNIVERSITY AND EDUCATIONAL NOTES

DR. HOWARD M. RAYMOND has been appointed president of the Armour Institute of Technology, filling the office that was made vacant by the death of Dr. Frank W. Gunsaulus last year. Since the death of Dr. Gunsaulus, Dr. Raymond had been serving as acting president. He has been with the institute for twenty-seven years, and since 1903 he has been dean of engineering.

ARTHUR J. WOOD, professor of railway mechanical engineering, has been appointed to succeed Professor E. A. Fessenden as head of the department of mechanical engineering at the Pennsylvania State College. Professor Fessenden goes to the Rensselaer Polytechnic Institute.

DR. WALLACE CRAIG, professor of philosophy and psychology in the University of Maine, has resigned. He will spend a half year in Great Britain and Germany. Dr. H. M. Halverson, of Clark University, has been appointed professor of psychology in the University of Maine.

DR. CARROLL C. PRATT, instructor in experimental psychology at Clark University, has been appointed instructor in psychology at Harvard University, where he will be associated in the laboratory with Dr. Langfeld and Dr. Boring. Dr. Floyd H. Allport, instructor in psychology at Harvard has been called to an associate professorship at the University of North Carolina.

ASSOCIATE PROFESSOR JACOB O. JONES, of the department of mechanics at the University of Kansas, has been appointed associate professor of hydraulics in the College of Engineering and Architecture at the University of Minnesota.

DR. E. P. CHURCHILL has been promoted from the position of assistant professor of zoology in the University of South Dakota to the professorship of zoology.

DISCUSSION AND CORRESPONDENCE

THE THERMEL

IN the early literature thermoelectric generators were classified, regardless of use or character, according to the number of their parts, into thermocouples and thermopiles. Some years ago, when it became clear that thermoelectric thermometers of widely differing complexity were going to be frequently used interchangeably or in combination, it seemed desirable to have a single not too lengthy name for them. The word "thermoelement," though not fully satisfactory, seemed to be the only word in use which would answer, and was accordingly proposed, in a paper from this laboratory, as a shorter synonym for thermoelectric thermometer. Its rather wide adoption indicates that the idea of a single short name for all thermoelectric thermometers is generally welcome, but the somewhat equivocal term, thermoelement, has been the means of some confusion. Leading writers, even, have spoken of such things as "multiple *thermo-couples,*" "thermocouple elements," "a multiple thermo-*couple* of four elements."

It therefore has seemed better to use the modified form "thermel." Logically, this may be taken as an abbreviation either of "thermoelement," or of "thermoelectric thermometer," both now in use. It is a handier word, even, than "thermometer" itself, and has received considerable approval. Since there appears to be, unfortunately, no authoritative body to which new terms can be referred for acceptance or rejection, we in this laboratory are taking the responsibility of using thermel in our publications, and recommend its general use. A thermel, then, may be a single thermocouple, or a *multiple thermel* or *thermopile,* containing more than one couple. Its distinguishing characteristic lies in being used for temperature

measurement. The term "thermocouple" may, unmolested, preserve its original application to a single couple only. The term "multiple thermel" seems rather better than "thermopile" since it classes its object with other thermels or thermoelectric thermometers, whereas "thermopile" is more commonly associated with current generators, or with the special thermometry of radiation measurement.

WALTER P. WHITE

GEOPHYSICAL LABORATORY,
CARNEGIE INSTITUTION OF WASHINGTON,

SOLAR ENERGY

"Creative Chemistry," by Edwin E. Slosson, M.S., Ph.D. (The Century Company), is a most interesting account of the astonishing number of important practical uses, in industry and war, of applied chemical science. For the benefit, apparently, of readers who are not educated chemists, or physicists, it makes occasional statements of pure science. One of these has the effect to revive the inquiry whether such statements ought not to refer to the observations or experiments on which they are based, unless readily available elsewhere. It reads: *"Solidified Sunshine.* All life and all that life accomplishes depend upon the supply of solar energy stored in the food." This is, in substance, but a repetition from prior publicists, many of them distinguished.

For example, Dr. Schuchert says: "Plants convert the kinetic energy of sunlight into the potential chemical energy of foodstuffs. Animals convert the potential chemical energy of foodstuffs into the kinetic energy of locomotion." And Dr. Soddy says: "Energy may sleep indefinitely . . . . In the potential form in coal, it has persisted for untold ages. Once released, heat is the sole ultimate product."

A quite extensive search has failed to find, in any literature, the account of an observation or experiment as leading to such conclusion. An elementary item of chemical teaching is that the sun's rays convert (approximately) 44 weight units of the comparatively inactive gas, carbon dioxide, into 32 like units of the universally active gas, oxygen, and 12 like units of carbon, ultimately a solid possessing no readily perceptible activity and incapable even of combination without the application of external heat. It is not easy for a non-specialist to believe, without evidence, that the energy of the sun's rays which decomposed the 44 units of the dioxide, adhered to the 12 units of carbon, and perhaps fell asleep there, while no noticeable amount went into the activity of the 32 units of oxygen.

FRANCIS B. DANIELS

SCIENTIFIC WORK IN RUSSIA

SCIENTIFIC men may be interested in the following letter that I have received from Dr. Th. Fjeldstrup, of the Russian Museum at Petrograd:

The effect the arrival of this letter will have produced on you is probably that of something dropping into your hands out of space.

It is of no use speculating on the possible ideas you had as regards my fate, no more than on the picture you Americans have imagined to yourselves of the state of Russia's home life to-day, since they are based on scraps of news, often defective, given in papers or obtained otherwise—our two worlds have been separated too long and too completely in their intellectual life to know much of each other.

Often and often did I feel tempted to recommence correspondence with you, but the prospect of being read a year or so after having written, if at all, cut short all attempts of the kind. I have better hopes now and therefore I permit myself to remind you of my existence and send you my best greetings.

After an absence of almost full four years (since end of February, 1918), I returned to Petrograd two months ago. Throughout this long period I have had various occupations, not always agreeable to my inclinations, but this was unavoidable, nor could one expect to be allowed to choose. The scene lies beyond the Ural Mts.

I do not intend to waste your time by giving a detailed description of my doings in the run of these years. I shall only dwell for a moment on some facts that might interest you.

The summer of 1920 I spent as a member of a scientific research party sent out by the University of Tomsk in the region that you paid a short visit to before joining me in Verchni-Udinsk, viz., the Minusinsk region. The city of Minusinsk and its museum I visited twice. The curator of the museum is a new man since you saw it, but the

state in which the archeologic collections are is exactly the same, I suppose—no worse. Mr. Kozevnikoff (the curator) is a zoologist.

Part of my time was dedicated to work among the natives (folklore and collections) and part to excavation of the Bronze age mounds (kurgans) under the directions of Professor S. Rudenko—Professor Volkov's pupil and his successor at the University of Petrograd now. (By the way, I suppose you have heard that Volkov, Radloff, Princes Oukhtomsky—son and his father quite recently—are no more).

Last summer we spent a couple of months with the Kirghiz of the Turgai region, "taking stock," so to say, of possibilities for work on a larger scale, if circumstances permit. Anthropometric measurements (800 individuals) and 2-3 Neolithic stations were among the results.

Next spring and summer I may return to the Kirghiz—they are in my department at the Russian Museum with which I am now scientifically connected.

In spite of unfavorable conditions and difficulties scientific work in Russia has not ceased to progress, and scientists of all classes continue their field and home studies with all the energy they are capable of. There is one great privation of which we are acutely sensible, and that is—book famine. We are so thoroughly isolated that scarcely any literary news comes filtering through the frontier. The appearance of a copy of some comparatively fresh publication from the outside world becomes known immediately to the circles interested in its subject, is welcomed with joy and every one tries to get at the book and have it lent to him for a time; individual book, periodicals, pamphlets, all one.

Without knowing what goes on elsewhere in science one feels like going about with plugs of cotton wool in one's ears.

Now, Professor Rudenko, with whom I am on very friendly terms, begs me to put a businesslike question to you in a quite unofficial way.

During your stay in Petrograd in 1912, you spoke to Professor Volkov and Pr. Oukhtomsky of the desirability of establishing here a bureau for the exploration of the northeastern portions of Siberia by Russians with American cooperation. Having this idea of yours in mind, Rudenko, who is now the curator of the Siberian Department and is proposed to the post of director of the Russ Museum,[1] would like to know whether you still think this project practicable, and if so would your or any other institution wish to participate in the realization of a series of expeditions to the Far East (Mongolia, the Amur region, Central Siberia) which would make it possessor of scientific results and collections. The Russ Museum has a sufficient number of well qualified explorers. The question of fitting them out for the field may prove difficult in some respects; but such difficulties would be easily allayed if the work were planned on the principles of cooperation.

[1] Formerly the Museum of Alexander III.

Aleš Hrdlička

U. S. National Museum

DOCTORATES IN AGRICULTURE

In Science, Vol. LV, page 271, appears an article by Callie Hull and Clarence J. West on "Doctorates conferred in the sciences by American universities in 1921." Three theses are listed for the subject of agriculture. There are in universities, generally, no departments of agriculture, but colleges of agriculture consisting of departments using methods of their own development and methods of the different sciences in studying agricultural problems.

Students being trained for work in such departments are listed in the article mentioned as having done their work primarily in bacteriology, botany, chemistry and zoology, perhaps because the titles indicate that the methods of these sciences were used. The fact remains, however, that they were preparing to study agricultural problems. Thus, at Cornell University alone, at least fifteen of the persons named under these four sciences were working in the College of Agriculture, preparing to study agricultural problems. And from the titles, I can be certain of at least four such men for other universities.

If no names had been listed under the subject of agriculture, no harm could have been done, but to list a subject of agriculture with only three names, it seems to me, might leave the impression that, with the great development of the agricultural colleges, there is very little tendency for workers to secure the training necessary to attack problems in an effective way. I believe that every one acquainted with the conditions in the colleges is convinced that there is a very hopeful development of graduate work and that the number of young men who are securing sound training for effective

work in agricultural subjects gives promise of very sound and rapid growth in agricultural research.

W. H. CHANDLER
NEW YORK STATE
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THE WRITING OF POPULAR SCIENCE

TO THE EDITOR OF SCIENCE: The letters of Dr. Dorsey and Dr. Slosson, which have appeared in SCIENCE, raise questions that have perplexed both scientists and editors of popular scientific magazines. Neither Dr. Dorsey nor Dr. Slosson, in my opinion, has struck at the root of the matter.

So long as the standards of American journalism are what they are, it will be difficult to enlist the whole-hearted cooperation of scientific men in popularizing the results of their researches. A distinguished biologist put the matter thus to me a few years ago: "We do not mind being popularized, but *we do mind being made ridiculous!*"

And there we have the whole truth in a nut-shell. Consider these facts which have come under my notice:

In the basement of the Bureau of Standards is an electric furnace used for conducting experiments at high temperatures. A Washington reporter, in quest of good red journalistic meat, was permitted to see that furnace in operation. On the following day there appeared an article from his pen in a Washington newspaper under the title, "Bureau of Standards Has Little Hell in Basement." Is it any wonder that the men in the Bureau of Standards look at him askance now?

During the days when Halley's comet was the subject of almost daily newspaper articles, about twenty Chicago reporters camped on the grounds of the Yerkes Observatory. Fearing complete misrepresentation of the work that they were doing, the members of the observatory staff granted no interviews. Finally, one ingenious reporter suggested that he be permitted to photograph the entire staff on the steps of the observatory. Inasmuch as all the reporters had been treated rather haughtily, it seemed as if this harmless request might be granted. Accordingly, the staff posed. Two days later, there appeared in a Chicago newspaper a photograph of one of the astronomers—a distinguished telescopic observer—seated at the eye piece of the huge Yerkes refractor, but in a position outrageously absurd. His photograph had been cut out of that made on the observatory steps, pasted upon a lifeless picture of the refractor, and the whole reproduced, with results that astonished every astronomical observer who saw the newspaper. The observatory staff was kept busy explaining to its colleagues all over the country how this absurdity was perpetrated.

Washington scientists surely have not forgotten the great injustice done to Samuel P. Langley at the time when his historically important experiments with his man-carrying airplane were conducted. If ever a scientist's life was embittered and shortened by gross newspaper misrepresentation, it was Langley's.

Our newspapers and magazines are right in demanding what they call "human interest." It is what science does for mankind that is interesting. The best popularizers of science have always been humanly interesting—particularly the men who have had theories to propound which were not readily accepted by their colleagues.

The campaign waged by Darwin and his colleagues was a conspicuous example of sound popularization. But our newspapers and magazines ride human interest too hard. The one thing that seemed to strike our reporters about Einstein was the fact that he smoked a pipe and that his hair was disheveled. At the moment, I do not recall more than two articles on Einstein in the newspapers that pointed out the tremendous practical significance of his theory of relativity—the fact that chemists, physicists, engineers and astronomers must henceforth reckon with time, space and motion in a new way. What Edison eats for breakfast seems to be of more importance than what Edison has actually achieved. So long as our newspapers publish simply gossip and the news of death and destruction, we have little to hope from them. If anyone were to write a history of the United States one hundred years hence, with no other information before him than that contained in current newspapers, he would inevitably draw the conclusion that Americans of our day led scandalous private lives and

were savagely addicted to killing one another. Curiously enough, only the advertisements would save him from presenting an utterly distorted picture of present day life and manners.

Since these are the editorial standards of the day, is it any wonder that scientists hold aloof from the reporter? Is it any wonder that they *do not wish to be made ridiculous?*

In Europe it is otherwise. I have never had any difficulty in securing whole-hearted cooperation from English, French and German scientists. They send their portraits on request—something that American scientists hesitate to do. They write delightful scientific *feuilletons,* many of them models of simplicity and clarity. They recognize their journalistic obligation to the public at large. But when they come to this country, they soon learn the wisdom of withdrawing into their shells.

The newspaper and magazine editor constantly uses the stock argument that he "gives the public what it wants." But does he really know what the public wants? Would any magazine or newspaper editor have predicted that Wells' *Outlines of History* or Van Loon's *Story of Mankind* would have sold in editions of one hundred thousand and more?

The *Saturday Evening Post,* with a circulation of over two million, publishes articles on economics and industry which are, in the main, excellent examples of what the popularization of technical subjects should be. It has its standards of human interest, but it does not forget that the *facts,* simply, humanly, and interestingly presented are "what the public wants."

It is possible that the schools of journalism which have been established in various parts of the country may bring about a reformation of editorial standards through their graduates. Not much is hoped for from the publishers themselves.

WALDEMAR KAEMPFFERT

MR. SLOSSON'S indictment of American scientists, in your issue of May 5, for their failure to write interestingly and attractively about their work is all too true. As a teacher of English, I have observed the same failure throughout our universities. Among both faculty and students an opinion prevails that there are but two general ways of writing: a so-called literary and polished style fit only for esthetes and poets; and a crude, inchoate style that marks the profound researcher and busy technician. The scientific man generally thinks that he hasn't time to "polish" and "adorn" his sentences; therefore he slips into the slovenly jargon that he sees is customary among his colleagues. He fails to notice that there is a middle ground of simple, clear English that can be made interesting and attractive without his becoming a poet or an esthete. Mr. Slosson's English is an example. Another example of a scientific man who taught himself to write excellent English was Professor John W. Draper, of New York University. His volume of "Scientific Memoirs" is a model of clear, incisive prose.

Professor Draper won the Rumford medals and was the first president of the American Chemical Society. But look at the accounts of chemical research as published to-day, and see what they have become from the point of view of English or readableness. Look at the tiresome, too-modest statements, phrased in passives and circumlocutions to avoid saying "I" or "me." Pick a sentence at random and try to tell what it means without reading it several times. Such a style is supposed to indicate the scientific, objective researcher. The awkward sentences and confused transitions are supposed to connote the profound scholar intent on his specialty. The curious thing is that many chemists can write well if they choose. But when they begin to explain their work, they drop into professional jargon, which disguises their real ability. Such jargon is the custom. It makes all the articles alike, looks technical, dulls the interest, eliminates the personal element, and discourages discussion.

Mr. Slosson hints that he would like to see the great events in the history of science described in their proper dramatic significance. So should I, and if such descriptions could be included in a text-book on the history of science for use in colleges, it would be a great benefit to teachers.

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To the Editor of Science: There is one point in Dr. Allen's letter of April 28 that I think will bear further emphasis. As he points out, most editors will print sound scientific "stuff" which they can get for nothing. But they won't pay a living wage to the man who writes it.

I have been doing this sort of work, off and on, for a quarter century. In fact, for some years I actually supported myself—at about the clerical level. Those were the days when "the Old Man" edited McClure's and cared more for the permanent repute of his magazine than for selling out any single issue. Newspaper work paid decently. One could occasionally make a short story of a scientific item. Even the women's publications used to buy semi-scientific articles on diet and child training.

Now all this is past; I haven't tried to sell anything since the war. It takes about as long to verify all the statements in one article as it does to write another. The verification is a labor of love, for which no editor will pay. The writer with an unhampered imagination can turn out stuff that the public prefers; and he can do twice as much of it in a day. My old market is absolutely dead. In the present day market, I can compete neither with the men who are selling their product, nor with those who are giving it away.

Dr. Allen's solution, I heartily agree, is for the moment the only practical one—though I doubt whether, in the long run, the public will get much good out of anything that it isn't willing to pay for. Nevertheless, I cannot help thinking that the condition which Drs. Allen and Slosson are trying to cure is only a symptom, not the real disease. For the fact is that the world just now is being simply drowned in a vast wave of superstition, that is bringing in every sort of pre-scientific opinion that the nineteenth century thought disposed of for good and all. My own town, for example, makes education its leading industry. But our public library has to buy books, just off the press, on palmistry, handwriting, character reading and fifty-seven other varieties of nonsense; while, significantly, it owns no old volumes on any such topics. The current number of the *Atlantic Monthly* carries the advertisement of a professional astrologer!

Here then lies the real trouble: The reading public does not know good science from bad; but if it did, it would certainly choose the bad.

E. T. Brewster

Andover, Mass.

NOTES ON METEOROLOGY AND CLIMATOLOGY

THE STREAMFLOW EXPERIMENT AT WAGON WHEEL GAP, COLORADO

Students of hydrology have always had a keen interest in the relation of run-off to the forestation of watersheds, and there has been much theorizing as to the probable relation. But there are so many factors involved—evaporation, transpiration, interception, etc., these, in turn, being influenced by the geological, phenological, and meteorological character of the watershed,—that it is difficult, if not impossible, to estimate correctly the degree of influence of each. It has been the purpose of the Forest Service and the Weather Bureau to conduct an actual experiment in order to obtain quantitative measures of these influences and, in general, the response of streamflow to a forested and denuded watershed. The site selected for this large-scale experiment is near the railroad station of Wagon Wheel Gap, Colorado, the station having an elevation of 8,437 feet above sea-level. The plan was to select two contiguous watersheds of similar character, make extensive meteorological and hydrological observations on each, and, after the lapse of a certain number of years, denude one watershed of its trees and continue observations for a sufficient number of years to determine in what manner the streamflow is influenced.

On June 30, 1919, an eight-year continuous series of stream-flow observations and a nine-year meteorological record had been obtained, and, after a general survey of the results, it was decided that the trees could properly be removed from one watershed. The denudation was completed in the autumn of 1920. This, therefore, marked the completion of the first stage of the experiment. Observations are being continued, and will continue for several

years, but the report on the first stage has just been published.[1] The Forest Service is represented by Carlos G. Bates, silviculturist, and the Weather Bureau by Professor A. J. Henry, meteorologist, the reports representing joint authorship.

While an effort was made to select watersheds of similar character, it is obvious that, no matter how good the general agreement of the main features, exact duplication was impossible. Watersheds *A* and *B* at Wagon Wheel Gap, therefore, have certain characteristics in which they are quite different. Through these two small valleys flow tiny streams which descend toward the Rio Grande. The streams are approximately parallel in their lower portions and flow, in a general direction, from west to east. The area of the south watershed, *A*, is 222.5 acres and that of the north watershed, *B*, is 200.4 acres. The lower point of *A* is 9,373 feet and the upper point 11,355 feet above sea-level. Corresponding elevations for *B* are 9,245 feet and 10,952 feet above sea-level. These facts are not as significant, so far as this study is concerned, as the fact that watershed *A* is relatively long and narrow, while *B* is short and fan-shaped. These characteristics exert considerable influence upon the rate of runoff, for, owing to the short, steep, slopes of *A*, the flood crest arrives more quickly than in *B*, but falls sooner, then comes to a secondary maximum of longer duration, because of the greater length of the watershed. The flood at *B* exhibits no secondary maximum because the water reaches the dam from all parts of the watershed at approximately the same time. Moreover, *A* and *B* lying in different directions, as explained above, involves a difference in the rate of snow melting owing to the different exposure of the slopes to the sun; this has an effect upon the streamflow. The geological character of the two watersheds has been found to be the same. The trees consist largely of Douglass fir, although there is a considerable sprinkling of bristle-cone pine and Englemann spruce, the distribution depending upon the altitude, the exposure of the slope, and the amount of rock in the soil.

The observing equipment is of two kinds, meteorological and hydrological. Six primary meteorological stations were established at the beginning of the experiment, one at the base and one in the upper reaches of the streams, and two in each of the valleys. The equipment of these stations varies according to the topographic features in the vicinity; but, among them are to be found maximum and minimum thermometers, psychrometers, thermographs, soil thermoscopes, hygrographs, anemometers, raingages, and snow bins. The headquarters station is the most completely equipped, having two standard barometers, and a triple register for recording automatically wind direction and speed, precipitation and sunshine. On *A* there are 18 snowscales—graduated stakes 12 feet high—and on *B*, 14 scales, the location of each having been carefully selected so as to be representative of the snowfall on a given acreage.

The hydrological equipment consists of a dam in each stream so constructed as to make the surface and subflow of the streams available for measurement. Back of the dams are concrete basins in which continuous automatic record of the waterstages is kept by a Friez recorder. The instrumental record is checked daily by a reading with the hook gage, the latter being so accurate that several observers do not differ more than 0.001 foot on a given reading. The dams at first had rectangular weirs, but for these triangular weirs were later substituted.

The following facts are shown by the nine years of meteorological observations: (1) The mean minima for identical periods and times are slightly higher for slopes facing south than for those facing north, but the greatest differ-

[1] Bates, Carlos G., and Henry, Alfred J.: "Streamflow Experiment at Wagon Wheel Gap, Colo." *Mo. Weather Rev. Supplement No. 17*, pp. 55, figs. 41. A very complete paper representing a summary and extracts from the *Supplement* was published in the *Mo. Weather Rev.* for December, 1921, under the same title, pp. 637-650. Believing that separates of this shorter paper will satisfy those who have an academic, rather than a professional, interest in the subject, a limited number of reprints are now available. Application should be made to the Chief of the Weather Bureau, Washington, D. C. Copies of the complete report, *Supplement 17*, may be obtained at 50 cents each from the Superintendent of Documents, Government Printing Office, Washington, D. C.

ence for any month does not exceed 1° F. Comparing corresponding slopes of the two watersheds, the mean temperature is substantially the same. (2) Precipitation occurring as rain is practically equal on both watersheds. If the soil is saturated, as small a rain as 0.01 inch may cause the streamflow to respond; but ordinarily rains of 0.10 inch or less in summer merely replenish losses due to evaporation or transpiration, and do not affect streamflow appreciably. Most of the summer rains are not in excess of 0.25 inch, hence it is seen that summer rains are not, in general, of great importance. (3) A little less than 50 per cent. of the precipitation is snow, but it yields more than half the runoff. The average depth of snow per season is 113.3 inches. The maximum observed was 149.7 inches and the minimum 80.7 inches.

Interesting features of the streamflow records are: (1) Stream *A* rises more rapidly than *B* and reaches a maximum sooner than *B*, but before the flood has subsided a secondary maximum with a steadier flow may occur at *A*. This feature, as mentioned above, is easily explained by topography. (2) Winter and autumn show very little diurnal variation of streamflow; summer is more marked, with a maximum in the early morning hours and a minimum between 1 and 2 o'clock in the afternoon; spring, however, with the great amount of melting snow, has a pronounced diurnal period owing to alternate freezing and thawing. The amplitude of variation is greater at *A* than at *B*, and the *A* maximum and minimum are more pronounced. (3) An estimated disposition of 21.00 inches of precipitation, the average annual amount for eight years observations, is shown for *A* as follows:

Evaporation	7.39 inches
Transpiration	3.91 inches
Interception	3.62 inches
Runoff	6.08 inches
Total	21.00 inches

It is clear that the objective of all these studies is an accurate estimate of the relations between the various factors on *A* and *B* in order that, in the years following denudation, the conditions on *A* can be used as an index to what would have occurred on *B* had denudation not been effected. It is only in this way that the effect of the presence or absence of trees can be ascertained. Much of the paper, therefore, is devoted to these relations in too great detail for abstracting. Thirteen "rules" are developed as statements of these relations to be used in the later discussions. These concern ratios of discharges in different periods and at different times, time intervals between crests, probable height of crests, and the deposition of silt.

This experiment is of great practical importance with respect to hydrological problems—floods, irrigation, etc., and its outcome will doubtless be watched with the greatest interest by those who are concerned with these problems.

C. LEROY MEISINGER

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SPECIAL ARTICLES

AN EARLY STAGE OF THE FREE-MARTIN AND THE PARALLEL HISTORY OF THE INTERSTITIAL CELLS

THE theory that the intersexual condition of the free-martin depends upon hormones secreted by interstitial cells of the testis of the male twin and distributed by its blood to the female depends primarily upon the demonstrated connection between fœtal vascular anastomosis and the intersexual condition of the female twinned with a male calf, and secondarily on comparative data. The time of effective action of the male hormone has been presumed to be very shortly after the beginning of sex-differentiation in the embryo (Lillie, '17) owing to the known normal condition of the embryonic membranes in such stages, which renders vascular connection possible, and the very profound nature of the effect. The earliest stage of the free-martin hitherto described is 7.5 cm greatest length (Lillie, '17; Chapin, '17). Sex-differentiation begins at approximately 2.5 cm. The gap thus indicated in our knowledge of this phenomenon is now largely filled up by study of a free-martin of 3.75 cm greatest length, and of the complete history of the interstitial cells of the testis and ovary from 2.5 cm throughout life.

In the 3.75 cm free-martin the gonad is much less than half the bulk of those of normal males and females of corresponding age. The germinal epithelium (cortex of ovary) is only about one fifth the thickness of that of the normal female of corresponding age and less developed than a female of 3 cm greatest length. The blood of the male has already operated to inhibit growth of the entire gonad and to stop the differentiation of the cortex. The specific male sex-hormone is thus demonstrably present in the blood at this stage.

Interstitial cells appear in the testis of the normal calf embryo between the stages of 2.7 and 3 cm greatest length. At the latter stage they are identical in size and histological structure with those of later stages and the adult; they have a continuous history up to adult age. In the female, on the other hand, comparable cells do not appear in the ovary until about the time of birth.

The following conclusions may be drawn:

1. The appearance of interstitial cells in the testis at the very time that a male hormone may be demonstrated by its physiological effects (free-martin) is strong evidence that these cells secrete the sex-hormone.

2. The absence of such cells in the female and the corresponding lack of effect of the female blood on the male twin argue in the same sense.

3. In the female of cattle sex-differentiation before birth is apparently due to genetic factors exclusively; in the male the genetic factors are intensified by the production of a hormone.

The detailed data will be published shortly by the authors separately, Mr. Bascom dealing with the interstitial cells.

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MAY 18, 1922

THE EFFECT OF ACID ON CILIARY ACTION AS A CLASS EXERCISE IN pH

THE effects of changes in hydrogen-ion concentration have received so much attention in the recent literature that it has become desirable to incorporate some exercise into laboratory courses in physiology which will illustrate the principles by which the p_H of a solution is determined. For the majority of college laboratories "gas chain" apparatus, potentiometers, etc., are out of the question for student work. The colorimetric method, however, which is very simple and sufficiently accurate for general laboratory problems, can be used to good effect at very little expense.

For our class in general physiology consisting of some twenty students in their second and third college years, we have outlined an experiment on the stopping of ciliary movement in the epithelium of the frog's esophagus by acid which has proved most successful. The experiment is in the form of a problem, and is stated thus: "Find the concentration of acid which will stop ciliary action within approximately three minutes." The students work in pairs. A small bit of ciliated epithelium is placed on a slide, and while one student observes this under the low power of the microscope, the other places upon the tissue a few drops of acid, and records the time. When the concentration has been found which stops the movement of cilia in three minutes, an indicator is added in the correct proportion (Clark, '20, p. 40) and the p_H determined by matching the resulting color with the appropriate color in the color chart.

When acetic acid diluted with distilled water was used with brom phenol blue as indicator, the following answers were handed in by the class:

Motion stopped in less than 2 min., $p_H = 3.4$, 2 groups of students.

Motion stopped in 3 min., $p_H = 3.5$, 6 groups of students.

Motion stopped in 3½ min., $p_H = 3.6$, 1 group of students.

Motion stopped in 9 min., $p_H = 3.8$, 1 group of students.

The agreement between these results is, we think, very good for an ordinary class exercise.

It should be noted that ordinary distilled water is decidedly acid, $p_H = \pm 6.3$, and that cilia cease to beat in it within approximately half an hour. In 0.7% NaCl, the beating continues for a day, and in Ringer's solution for three or four days at room temperature. For

purposes of strict accuracy, therefore, the acid should be added to normal saline or Ringer's solution, but for class purposes the distilled water will serve.

The experiment has been designed not only to show the stopping of ciliary action at a definite hydrogen-ion concentration, but also to bring out the difference in effect between an organic acid, such as acetic, and a mineral acid, such as hydrochloric. In the latter case even a concentration, $p_H = 2$, thymol blue as indicator, will not stop the beating of the cilia in less than 15 minutes. The greater concentration of hydrogen-ion required for the mineral acid than for the organic acid is of course correlated with the difference in rate of penetration of these acids into tissues.

Furthermore, in order to obtain comparable results the pieces of epithelium must be from corresponding regions of the frog. If the tissue is taken from the more posterior levels, *i. e.*, from within the esophagus itself, where the cilia are very long, it is found that the beating continues for a longer time in a given concentration of acid than in the pieces from more anterior levels, *i. e.*, the back of the mouth, where the cilia are very short. The experiment therefore brings out the fact that susceptibility to acid decreases in passing from anterior to posterior levels of the alimentary tract.

J. M. D. Olmsted
J. W. MacArthur
University of Toronto

Reference: W. M. Clark, 1920, *The Determination of Hydrogen-Ions.*

THE SOCIETY OF MAMMALOGISTS

The fourth annual meeting of the Society of Mammalogists was held in New York City on May 16 to 18, 1922, where the society was invited to hold its meetings at the American Museum of Natural History. Besides the regular business sessions and the election of new officers, papers were presented, and the program is given as follows:

Tuesday, May 16

Afternoon Session, 2:00 P.M.

The present status of the elk: E. A. Goldman.

Mammals of the mountain tops: William L. Finley. (Presented by John Treadwell Nichols).

The water supply of desert mammals: Vernon Bailey.

A quantitative determination of damage to forage by the prairie-dog, cynomys gunnisoni zuniensis Hollister: Walter P. Taylor.

Studies of the Yellowstone wild life by the Roosevelt Station: Charles C. Adams.

The part played by mammals in the World War: Ernest Harold Baynes.

Evening Session, 8:00 P.M.

The members of the society were invited to the new home of the Explorers' Club, 47 West 76th Street. The board of directors of the club extended the courtesy of the club to the members of the society during their session.

Wednesday, May 17

Morning Session, 10:00 A.M.

The frequency and significance of bregmatic fontanelle bones in mammals: Adolph H. Schultz.

A fossil dugong from Florida: Glover M. Allen.

Certain glands in the dog tribe: Ernest Thompson Seton.

The elephant in captivity: W. H. Sheak.

The burrowing rodents of California as agents in soil formation: J. Grinnell.

Afternoon Session, 2:00 P.M.

Symposium on the Anatomy and Relationships of the Gorilla:

How near is the relationship of the gorilla-chimpanzee stock to man? W. K. Gregory.

Notes on the comparative anatomy of the gorilla: G. S. Huntington.

Was the human foot derived from a gorilloid type? D. J. Morton.

Reichenow's observations on gorilla behavior: J. H. McGregor.

On the sequence of eruption of permanent teeth in gorilla and man: Milo Hellman.

Phylogenetic relations of the gorilla: evidence from brain structure: Frederick Tilney.

Evening Session, 8:00 P.M.

The motion picture as a medium for intimate animal studies: Arthur H. Fisher.

Motion pictures, some showing slow motion, of anthropoidea, sea lion, Barbary sheep, kangaroo and yak, and the habits of the beaver: Raymond L. Ditmars.

Motion pictures of sea-elephants: Charles H. Townsend.

THURSDAY, MAY 18

Morning Session, 10:00 A.M.

Close of the age of mammals: HENRY FAIRFIELD OSBORN and H. E. ANTHONY.

Food-storing by the meadow-mouse: GLOVER M. ALLEN.

An evolutionary force of a wide range: ERNEST THOMPSON SETON.

The meetings were well attended, and among the members present were mammalogists who represented the leading institutions of the country, such as the United States National Museum, the Bureau of the Biological Survey, the Field Museum of Natural History, the Museum of Comparative Zoology, the Academy of Natural Sciences of Philadelphia, the American Museum of Natural History and the New York Zoological Society.

Among the many interesting papers that were given before the mammalogists was the "Symposium on the Anatomy and Relationships of the Gorilla." At this session the attendance was probably greater than at any of the others, and representatives of the press were present to make the most of a subject in which the public is at present so keenly interested. The consensus of opinion as expressed by the speakers in this symposium was that the gorilla stands very high among the anthropoids in its relationship to man, and the evidence presented, together with the detailed descriptions of the man-like characters of the anthropoids, set forth data for an argument which the anti-evolutionists would have great difficulty to refute.

At the last of the meetings for the presentation of papers, the "Close of the Age of Mammals" was given by Professor Henry Fairfield Osborn and Mr. H. E. Anthony. Professor Osborn took as his thesis the very rapid disappearance of our mammalia, which leads to the conclusion that the age of mammals will come to a close at no very distant date. After outlining the inception and the development of the age of mammals, illustrating his points by distributional maps, Professor Osborn stated that this age had reached its greatest development in the late Pliocene and early Pleistocene, at which time the glacial periods began the destruction which is receiving its final acceleration to-day at the hands of man. Having brought this outline of the history of the age of mammals down to the present day, Professor Osborn was followed by Mr. Anthony, who showed a chart of statistics and gave figures on the great destruction of mammal life which may be laid at the door of the fur trade. A discussion of the papers followed, during which Dr. W. T. Hornaday, the noted advocate of wild life conservation, spoke at some length upon the disappearance of present day mammals and urged the great necessity of untiring efforts to stave off complete extermination.

Further discussion was given by Dr. W. D. Matthew, Dr. Wilfred H. Osgood, Dr. Charles C. Adams and Dr. E. W. Nelson, all of whom were inclined to believe that it was no exaggeration to consider that the "Age of Mammals" was rapidly coming to a close, and that stringent measures are necessary to protect the surviving members. Dr. Adams, who is director of the Roosevelt Wild Life Forestry Extermination Station at Syracuse, N. Y., maintained that the only hope lies in education, not so much of the adult, as of the younger generation, and pointed out the advisability of establishing numbers of wild life preserves, so that people might come to know the wild life of their own region by visiting the local preserves.

The mammalogists were the guests of the American Museum at a luncheon on Tuesday, May 16, and were guests of the New York Zoological Society at luncheon on Thursday, May 18.

The annual dinner was held the evening of Wednesday, May 17, at the Hotel San Remo.

At the annual election of officers, all of those holding office were re-elected.

At the close of the morning session of Thursday, the members adjourned to the North American Hall of the American Museum where, by short exercises, the museum dedicated this hall to the memory of the late Dr. J. A. Allen, who was the society's only honorary member. The hall hereafter will be known as the J. A. Allen Hall of North American Mammals.

President Henry Fairfield Osborn presided and, on behalf of the trustees, made the dedication of the hall, which was accepted on behalf of the Division of Zoology and Zoogeography of the museum by Dr. F. M. Chapman. An

appreciation of Dr. Allen's services to natural history was given by Dr. E. W. Nelson, president of the Society of Mammalogists.

At the close of the luncheon given by the New York Zoological Society, the mammalogists were taken for a private view of the new halls of the National Collection of Heads and Horns and a tour through the park under the guidance of the officers of the Zoological Society.

PROGRESS IN ANIMAL PHOTOGRAPHY

The American Museum had planned for a prize exhibition of photographs of mammals to be held at the time of the meeting of the American Society of Mammalogists. This exhibition was opened to the public on May 15, and judges for the exhibition were appointed by President Nelson of the American Society of Mammalogists at the first business meeting of the society. The board of judges appointed by Dr. Nelson was as follows: Dr. Wilfred H. Osgood, chairman, Dr. Witmer Stone, Mr. Charles R. Knight, Mr. James L. Clark and Mr. H. E. Anthony.

The photographs were exhibited in the Hall of Forestry on the first floor of the museum, where they will remain on exhibition for a month. Some 1,654 photographs were received for this exhibition and there were 139 contributors. Requests for photographs and conditions of the contest had been drawn up and submitted by an American Museum Committee as follows: Mr. H. E. Anthony, chairman, Mr. Herbert Lang, Dr. Robert Cushman Murphy and Dr. G. Clyde Fischer, but the credit for the very unusual and splendid display of photographs which was brought together must be given to Mr. Herbert Lang, who worked day and night to make the exhibition a success. The unanimous opinion of the many who have seen this exhibition has been that it is easily the finest exhibition of mammal photographs ever displayed in this country. So many unusual photographs were submitted that the judges found it a difficult task to award the prizes, but finally made the following selection:

1. PHOTOGRAPHS OF MAMMALS IN THE WILD STATE

First prize: John M. Phillips, Mountain Goat.

Second prize: Norman McClintock, White-tailed Deer.

Third prize: Edmund Heller, Mountain Sheep.

First honorable mention: Carl E. Akeley, Hartebeest.

Second honorable mention: Donald R. Dickey, Deer.

Third honorable mention: Kermit Roosevelt, African Elephant.

Fourth honorable mention: Edward Mallinckrodt, Brown Bear.

Fifth honorable mention: Donald B. MacMillan, Polar Bear.

II. PHOTOGRAPHS OF MAMMALS IN CAPTIVITY

First prize: Elwin R. Sanborn, New York Zoological Park, Chimpanzee.

Second prize: J. E. Haynes, Bison Stampede.

Third prize: W. Lyman Underwood, Bay Lynx.

First honorable mention: Mr. and Mrs. Ernest Harold Baynes, Wolf.

Second honorable mention: J. B. Pardoe, Flying Squirrel.

Third honorable mention: Joseph Dixon, Cougar Kittens.

Fourth honorable mention: Leland Griggs, Fox Head.

Fifth honorable mention: Arthur H. Fisher, Lioness.

JOEL A. ALLEN MEMORIAL

One of the most important measures taken up by this meeting of the American Society of Mammalogists was the formulation of plans and the appointment of a committee for establishing a publication fund to be known as the J. A. Allen Memorial Fund. This fund has been set at $10,000, and the interest from this sum, when it has been properly invested, will be used by the American Society of Mammalogists for the publication of papers to constitute a series of continually appearing memorials to the late Dr. J. A. Allen. The committee appointed to raise this fund, and given full powers for this purpose by the society is as follows: Mr. Madison Grant, chairman, President Henry Fairfield Osborn, Mr. Childs Frick, Dr. George Bird Grinnell and Mr. H. E. Anthony.

It is expected that friends of Dr. J. A. Allen, mammalogists and students of wild life throughout the country will give their support toward the raising of this fund, since natural science has never had a more devoted student than Dr. J. A. Allen, and the purposes for which the fund will be devoted are outlined to give the greatest possible encouragement to research in mammalogy.